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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

198150US2SPCT

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/647926

INTERNATIONAL APPLICATION NO.
PCT/JP00/00820INTERNATIONAL FILING DATE
15 February 2000PRIORITY DATE CLAIMED
15 February 1999 (earliest)

TITLE OF INVENTION

CATHODE-RAY TUBE

APPLICANT(S) FOR DO/EO/US

Takuya MASHIMO, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☐ Certificate of Mailing by Express Mail
19. ☒ Other items or information:

Request for Consideration of Documents Cited in International Search Report

Notice of Priority

PCT/IB/304

PCT/IB/308

Copy of Specification, Claims and Drawings

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.53) 097647926		INTERNATIONAL APPLICATION NO. PCT/JP00/00820		ATTORNEY'S DOCKET NUMBER 198150US2SPCT	
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20. The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input checked="" type="checkbox"/> Search Report has been prepared by the EPO or JPO \$860.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) \$690.00 <input type="checkbox"/> No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$710.00 <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1000.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY <div style="border: 1px solid black; height: 100px; width: 100%;"></div>	
				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)). <input type="checkbox"/> 20 <input type="checkbox"/> 30				\$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	11 - 20 =	0	x \$18.00	\$0.00	
Independent claims	5 - 3 =	2	x \$80.00	\$160.00	
Multiple Dependent Claims (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$1,020.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable). <input type="checkbox"/>				\$0.00	
SUBTOTAL =				\$1,020.00	
Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)). <input type="checkbox"/> 20 <input type="checkbox"/> 30				\$0.00	
TOTAL NATIONAL FEE =				\$1,020.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL FEES ENCLOSED =				\$1,020.00	
				Amount to be: refunded	\$
				charged	\$


☒ A check in the amount of \$1,020.00 to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees.
 A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:


22850

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SIGNATURE _____

Marvin J. Spivak _____

NAME _____

24,913 _____

REGISTRATION NUMBER _____

Oct 16 2000

DATE _____

2/PRTS

09/647926

529 Rec'd PCT/PTO 16 OCT 2000

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D E S C R I P T I O N

CATHODE-RAY TUBE

5

Technical Field

The present invention relates to a cathode-ray tube having a reinforcing band for improvement of implosion-proof characteristics.

Background Art

10

Generally, a color cathode-ray tube comprises a vacuum envelope formed of glass. The vacuum envelope has a substantially rectangular panel and a funnel bonded to the panel. The panel integrally has a substantially rectangular effective portion and a frame-like skirt portion provided along the periphery of the effective portion and extended substantially perpendicularly to the effective portion. A phosphor screen including three-color phosphor layers for emitting lights of blue, green and red is formed on the inner surface of the effective portion.

20

A shadow mask having a number of electron beam passage apertures is arranged to face the phosphor screen, inside the vacuum envelope, and an electron gun for emitting three electron beams onto the phosphor screen is mounted in a neck of the funnel.

25

In the above-constituted color cathode-ray tube, three electron beams emitted from the electron gun are

deflected by use of a deflection yoke mounted on the outer side of the funnel, and scan the phosphor screen horizontally and vertically via the electron beam passage apertures, thereby displaying color images.

5 In a conventional color cathode-ray tube, the compressive stress is applied to the vacuum envelope by fastening the skirt portion of the panel by a reinforcing band, to improve the implosion-proof characteristics of the vacuum envelope.

10 The effective portion of the panel has a large curvature, in the conventional color cathode-ray tube. For this reason, even if the fastening position of the reinforcing band is set near center of the skirt portion with respect to the direction of tube axis,
15 the outward force generated at the effective portion of the panel by the fastening of the reinforcing band is substantially uniform on the overall surface of the effective portion. Thus, the stable implosion-proof characteristics can be achieved.

20 On the other hand, recently, a request to flatten the outer surface of the effective portion of the color cathode-ray tube has been increased for easy view of images.

25 In the conventional structure, however, problems will arise in relation to the implosion-proof characteristics when the effective portion is flattened. That is, if the outer surface of the effective portion

of the panel is flat or has a small curvature, the outward force generated at the effective portion of the panel by the fastening of the reinforcing band is extremely large at corners of the effective portion, in
5 the structure of fastening the vicinity of the center of the skirt portion in the direction of tube axis by the reinforcing band as seen in the prior art. For this reason, when the vacuum envelope is broken, the glass at the corners of the effective portion
10 easily flies, which worsens the implosion-proof characteristics.

Further, the deformation of the effective portion caused by the fastening of the reinforcing band is large. For this reason, when the compressive stress
15 applying to the effective portion is irregular, the irregularity in the deformation of the effective portion becomes larger. In accordance with this, the phosphor screen is also deformed and therefore the phosphor layers are shifted from their initial
20 position. As a result, the landing positions of the electron beams become irregular and the quality of images is deteriorated.

Disclosure of Invention

The present invention is accomplished in
25 consideration of the above circumstances, and its object is to provide a color cathode-ray tube capable of reducing the irregularity of the beam landing and

improving the implosion-proof characteristics.

To achieve the above object, a color cathode-ray tube according to the present invention comprises:

a vacuum envelope including a panel which has

- 5 a substantially rectangular effective portion having a substantially flat outer surface and having a phosphor screen formed on an inner surface and which has a skirt portion provided along a peripheral part of the effective portion and extended substantially
- 10 perpendicularly to the effective portion, and a funnel bonded to the skirt portion; an electron gun arranged in a neck of the funnel, for emitting electron beams onto the phosphor screen; and a reinforcing band attached round an outer surface of the panel, for
- 15 fastening the skirt portion, wherein the reinforcing band is attached to the skirt portion at a position closer to an outer surface side of the effective portion than to a central portion of the skirt portion, in a direction of tube axis of the vacuum envelope.

- 20 According to the above-constituted cathode-ray tube, the attachment position of the reinforcing band is near the panel effective portion outer surface in the direction of the tube axis. Therefore, the compressive stress caused by the reinforcing band is
- 25 easily applied to the effective portion of the panel and thus the external force at the effective portion is reduced. Thus, flying of glass constituting the panel

can be reduced and the implosion-proof characteristics can be thereby improved, on the effective portion of the panel. Further, deformation of the panel effective portion caused by the compressive stress of the reinforcing band can be reduced and the irregularity in the landing positions of the electron beams can be thereby restricted.

In addition, according to another cathode-ray tube of the present invention, when a distance in a direction of the tube axis from a bonding part of the panel and the funnel to an end of the reinforcing band on the outer surface side of the effective portion is represented by a and a distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h , the reinforcing band is arranged to have the relationship $a \geq 0.9h$.

According to the above structure, the compressive stress caused by the reinforcing band is easily applied to the effective portion of the panel and the external force at the effective portion can be reduced, and the flying of the glass can be reduced and the implosion-proof characteristics can be thereby improved. Further, the deformation of the panel effective portion caused by the compressive stress of the reinforcing band can be reduced and the irregularity in the beam landing positions can be thereby restricted.

In addition, according to the cathode-ray tube of the present invention, the reinforcing band has a bent portion formed by folding outwardly the end part of the reinforcing band on the outer surface side of the effective portion. When a distance in the direction of the tube axis from the bonding part of the panel and the funnel to an end of the bent portion on the electron gun side is represented by b and the distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h , the reinforcing band is arranged to have the relationship $b \geq 0.7h$.

Thus, by restricting the size of the bent portion of the reinforcing band to be $b \geq 0.7h$, the compressive stress can be improved near the only effective portion of the panel, even in the fastening range of the reinforcing band, and thereby the implosion-proof characteristics can be improved and the irregularity in the beam landing positions can be restricted.

Further, according to the other cathode-ray tube of the present invention, when a distance in the direction of the tube axis from the bonding part of the panel and the funnel to a mold matching line of the panel is represented by c and the distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h , the panel is arranged to

have the relationship $c \geq 0.8h$. The reinforcing band is attached round the skirt portion over the mold matching line.

5 According to this invention, the position of the panel mold matching line, where the compressive stress caused by the reinforcing band becomes maximum, is set to be $c \geq 0.8h$ and to be close to the outer surface side of the effective portion of the panel. Therefore, the compressive stress in the vicinity of the effective
10 portion of the panel can be improved, the flying of the glass can be reduced and the implosion-proof characteristics can be thereby improved. Further, the deformation of the panel effective portion caused by the compressive stress of the reinforcing band can
15 be reduced and the irregularity in the beam landing positions can be thereby restricted.

According to the other cathode-ray tube of the present invention, the reinforcing band and the panel have the relationships of $a \geq 0.9h$, $b \geq 0.7h$, and $c \geq$
20 $0.8h$, and the reinforcing band is attached round the skirt portion over the mold matching line.

According to the further cathode-ray tube of the present invention, the reinforcing band is attached over the mold matching line of the panel and the panel
25 has a part where an angle θ defined between the outer surface of the skirt portion from the mold matching line of the panel to the effective portion outer

surface and the direction of the tube axis is zero.

According to the above cathode-ray tube, the angle θ is zero, only at each of corners of the panel.

According to the above-constituted cathode-ray tube, the compressive stress caused by the reinforcing band is largely applied from the mold matching line of the panel to the skirt portion of the effective portion outer surface side. Therefore, the flying of the glass can be reduced and the implosion-proof characteristics can be improved. In addition, the deformation of the panel effective portion can be reduced and the irregularity in the beam landing positions can be restricted.

Moreover, according to the other cathode-ray tube of the present invention, when the thickness of the effective portion at an outer peripheral position of the phosphor screen is represented by t and the thickness of the effective portion at a central position of the phosphor screen is represented by t_c , the effective portion has a portion which satisfies the relationship of $t \geq 1.5t_c$.

Thus, the advantages achieved by satisfying the other conditions described above can be made further larger, by limiting the thickness of the effective portion.

A cathode-ray tube satisfying all the above-described conditions $a \geq 0.9h$, $b \geq 0.7h$, $c \geq 0.8h$, $\theta = 0$, and $t \geq 1.5t_c$ may be constituted. In this

case, the compressive stress in the vicinity of the panel effective portion can be certainly made larger, and the implosion-proof characteristics can be improved and the irregularity in the beam landing positions can be reduced.

Brief Description of Drawings

FIG. 1 is a partially cutaway, plan view showing a color cathode-ray tube according to an embodiment of the present invention;

FIG. 2 is a front view showing a panel of the color cathode-ray tube;

FIG. 3 is a diagram schematically showing the panel and a reinforcing band to explain structural parameters a , b , c , θ , t , and t_c of the color cathode-ray tube;

FIG. 4 is a sectional view showing the panel as seen along a line IV-IV of FIG. 2; and

FIG. 5 is a diagram schematically showing the ball impact method.

Best Mode of Carrying Out the Invention

A color cathode-ray tube according to an embodiment of the present invention will be explained in detail with reference to the accompanying drawings.

The color cathode-ray tube comprises a vacuum envelope 10 formed of glass, and the vacuum envelope includes a substantially rectangular panel 2 and a funnel 3 bonded to the panel, as shown in FIGS. 1

and 2. The panel 2 has a substantially rectangular effective portion 8 and a frame-like skirt portion 9 provided along a periphery of the effective portion to extend substantially perpendicularly to the effective portion, as one body. An outer surface of the effective portion 8 is formed to be substantially flat or to have a small curvature. A phosphor screen 1 having three-color phosphor layers for emitting light beams of blue, green and red is formed on an inner surface of the effective portion 8. The funnel 3 is bonded on an end surface of the skirt portion 9.

A shadow mask 12 having a number of electron beam passage apertures is arranged so as to face the phosphor screen 1 inside the vacuum envelope 10. An electron gun 5 for emitting three electron beams toward the phosphor screen 1 is arranged inside a neck 4 of the funnel 3. Engaging pins 14 protrude from plural parts of the inner surface of the skirt portion 9, and the shadow mask 12 is supported within the vacuum envelope 10 by engaging elastic support members 13 attached to the shadow mask with the respective engaging pins 14.

With the color cathode-ray tube having the above structure, a color image is displayed by deflecting the three electron beams emitted from the electron gun 5 by use of a deflection yoke 16 mounted on the outer surface of the funnel 3 and by scanning the phosphor

screen 1 horizontally and vertically via the electron beam passage apertures of the shadow mask 12.

A reinforcing band 7 for fastening the skirt portion 9 is attached around the entire periphery of the outer surface of the skirt portion 9 of the panel 2. The reinforcing band 7 is formed of an alloy in a substantially rectangular shape corresponding to the outer shape of the skirt portion 9. The end portion of the reinforcing band 7, on the outer surface side of the effective portion 8, is bent outwardly at 180 degrees to form a bent portion 7a, as shown in FIG. 3.

According to the present embodiment, to reduce the outward force generated at the corners of the effective portion 8 of the panel 2 by the fastening of the reinforcing band 7, the reinforcing band 7 is mounted to be closer to the vicinity of the outer surface of the effective portion 8 than to the vicinity of the center of the skirt portion 9, in the tube axis direction of the vacuum envelope 10, so that the compressive stress caused by the reinforcing band 7 can be further applied to the effective portion 8.

To explain in detail, if the distance in the direction of the tube axis Z from a bonding portion (a seal edge) between the panel 2 and the funnel 3 to the end of the reinforcing band 7 on the outer surface side of the effective portion 8 is represented by \underline{a} and if the distance in the direction of the tube axis Z from

the seal edge to the center of the outer surface of the effective portion 8 of the panel 2 is represented by \underline{h} , as shown in FIG. 3, the reinforcing band 7 is mounted at a position satisfying the following relationship

5
$$a \geq 0.9h$$

The size of the bent portion 7a on the effective portion 8 side of the reinforcing band 7 is restricted in order to increase the compressive stress in the only area near the effective portion 8, within the fastening
10 area of the reinforcing band 7. That is, if the distance in the direction of the tube axis Z from the seal edge to the end of the bent portion 7a on the electron gun 5 side is represented by \underline{b} , the reinforcing band 7 is formed to satisfy the following
15 relationship

$$b \geq 0.7h$$

The part of a mold matching line 11 of the panel 2, where the compressive stress applied by the reinforcing band 7 is made largest, is positioned to be
20 close to the outer surface of the effective portion 8 of the panel 2. If the distance in the direction of the tube axis Z from the seal edge between the panel 2 and the funnel 3 to the mold matching line 11 is represented by \underline{c} , the mold matching line 11 is formed
25 to satisfy the following relationship

$$c \geq 0.8h$$

The outer surface of the part from the mold

matching line 11 to the outer surface of the effective portion 8, in the outer surface of the skirt portion 9 of the panel 2, makes an angle θ (0 to 3 degrees) in the direction of the tube axis Z. To apply the compressive stress caused by the reinforcing band 7 more largely to the corners of the effective portion 8 of the panel 2, however, a part of the outer surface of the panel 2, i.e. each corner of the panel is formed such that the angle θ made by both the outer surface of the skirt portion 9 and the direction of the tube axis Z is zero degree in the area from the mold matching line 11 to the outer surface of the effective portion 8, as shown in FIG. 4. Therefore, at each corner of the panel 2, the area from the mold matching line 11 to the outer surface of the effective portion 8 also abuts on the reinforcing band 7. As a result, the compressive stress is applied to the area at each corner of the skirt portion 9.

As described above, the compressive stress caused by the fastening of the reinforcing band 7 can easily be applied to the effective portion 8 of the panel 2 and the outward force in the effective portion 8 can be reduced by setting the conditions of $a \geq 0.9h$, $b \geq 0.7h$, $c \geq 0.8h$ and $\theta = 0$ degree.

Thus, when the vacuum envelope 10 is broken, flying of glass pieces outwardly from the effective portion 8 can be reduced and implosion-proof

characteristics of the color cathode-ray tube can be improved. At the same time, deformation of the effective portion 8 which results from the compressive stress caused by the fastening of the reinforcing band 7 can be reduced and irregularity in the landing positions of the electron beams can be also reduced.

Next, the specific examples of the present invention will be explained.

Six kinds of color cathode-ray tubes (CRT) (1) to (6) different in the above-mentioned structural parameters a, b, c and θ as represented in the following TABLE 1 were used by use of a color cathode-ray tube in which a radius of curvature on the outer surface of the effective portion 8 of the panel 2 was about 10 m, to execute an implosion test.

Employing the ball impact method and the missile impact method, the implosion test was executed under the UL standards, which are the most strict safety standards in the U.S.A. As shown in FIG. 5, the test method was making a predetermined steel ball 20 or a steel missile collide with a predetermined area of the effective portion of the panel on each of the CRTs (1) to (6) by adoption of the principle of the pendulum and applying a predetermined impact thereto, and measuring the weight of glass pieces flying in front of the effective portion and the distance of flying. Thus, the test results represented in TABLE 1 were obtained.

TABLE 1

	h [mm]	a [mm]	b [mm]	c [mm]	θ [deg] (CORNER)	TEST RESULTS
CRT1	115	107 (0.930h)	87 (0.757h)	95 (0.826h)	0.0	⊙
CRT2	125	117 (0.936h)	82 (0.656h)	101 (0.808h)	2.0	○
CRT3	125	115 (0.920h)	80 (0.640h)	99 (0.792h)	2.0	△+
CRT4	100	90 (0.900h)	70 (0.700h)	77 (0.770h)	3.0	△-
CRT5	115	103 (0.896h)	73 (0.635h)	90 (0.783h)	3.0	×
CRT6	115	98.5 (0.857h)	78.5 (0.683h)	90 (0.783h)	3.0	×

As evident from the test results of TABLE 1, as for the CRTs (4) to (6), flying of the peeled pieces was very large and satisfying the UL standards was difficult. As for the CRT (3), the weight of the flying peeled pieces was small and the distance of flying was short, but the UL standards were slightly satisfied.

As for the CRT (2), flying of the peeled pieces satisfied the UL standards without problems. In the case of the CRT (1), the UL standards were satisfied and even a small implosion did not almost occur probabilistically, and as a result, very stable implosion-proof characteristics were obtained.

Therefore, it can be understood that flying of the glass from the effective portion 8 can be reduced and the implosion-proof characteristics can be improved by setting under the above-mentioned conditions of the present embodiment the structural parameters to be:

$$\begin{aligned} a &\geq 0.9h \\ b &\geq 0.7h \\ c &\geq 0.8h \\ \theta &= 0 \text{ (at the corners)} \end{aligned}$$

and by further applying the compressive stress caused by the fastening of the reinforcing band 7 onto the effective portion 8 side of the panel 2. In addition, by setting the above-mentioned conditions, the deformation of the effective portion 8 resulting from

the compressive stress caused by the fastening of the reinforcing band 7 can be reduced, and the irregularity in the beam landing positions associated with the irregularity in the compressive stress caused by the fastening of the reinforcing band 7 can be also reduced.

Next, the differences in the advantages of the respective conditions corresponding to thickness t were tested where the maximum thickness of the effective portion 8 located at the outer periphery of the phosphor screen 1 is represented by t and the thickness of the effective portion 8 located at the center of the phosphor screen 1 is represented by t_c , as shown in FIG. 3. Three kinds of color cathode-ray tubes (7) to (9) different in the thickness t were prepared and the implosion test was executed in the same manner as the above-described one. The relationship between the thicknesses t and t_c , and the test results as obtained at this time are represented below in TABLE 2.

TABLE 2

	t	TEST RESULTS
CRT7	$1.8t_c$	$\triangle+$
CRT8	$1.9t_c$	\bigcirc
CRT9	$2.2t_c$	\odot

As understood from the TABLE 2, as the thickness t of the effective portion 8 at the periphery of the phosphor screen 1 is larger than the thickness t_c of the effective portion 8 at the center of the phosphor

screen 1, the advantages obtained when the above conditions are satisfied become larger and the implosion-proof characteristics become more stable. Therefore, it is preferable that the effective portion 8 should be formed to satisfy the relationship

$$t \geq 1.5tc.$$

The present invention is not limited to the above-described embodiment, and can be variously modified within the inventive scope of the present invention. For example, the present invention cannot be applied only to a color cathode-ray tube, but also to a monochromatic cathode-ray tube.

Industrial Applicability

The present invention can provide a cathode-ray tube having the outer surface of the panel effective portion formed to be substantially flat, wherein flying of the glass pieces from the panel effective portion can be reduced and the implosion-proof characteristics can be improved, the deformation of the panel effective portion resulting from the fastening of the reinforcing band can be reduced, and the irregularity in the beam landing positions can be also reduced, by arranging the reinforcing band so as to allow the compressive stress caused by the reinforcing band to be applied onto the panel effective portion side.

The present invention can also provide a cathode-ray tube wherein flying of the glass pieces from

the panel effective portion can be reduced and the
implosion-proof characteristics can be improved, the
deformation of the panel effective portion resulting
from the fastening of the reinforcing band can be
5 reduced, and the irregularity in the beam landing can
be also reduced, by setting the structural parameters
a, b, c and θ at appropriate values.

C L A I M S

1. A cathode-ray tube comprising:

a vacuum envelope including a panel which has a substantially rectangular effective portion having a substantially flat outer surface and having a phosphor screen formed on an inner surface and which has a skirt portion provided along a peripheral part of the effective portion and extending substantially perpendicular to the effective portion, and a funnel bonded to the skirt portion;

an electron gun arranged in a neck of the funnel, for emitting electron beams onto the phosphor screen; and

a reinforcing band attached round an outer surface of the panel, for fastening the skirt portion,

wherein the reinforcing band is attached to the skirt portion at a position closer to an outer surface side of the effective portion than to a central portion of the skirt portion, in a direction of tube axis of the vacuum envelope.

2. A cathode-ray tube comprising:

a vacuum envelope including a panel which has a substantially rectangular effective portion having a substantially flat outer surface and having a phosphor screen formed on an inner surface and which has a skirt portion provided along a peripheral part of the effective portion and extending substantially

perpendicular to the effective portion, and a funnel bonded to the skirt portion;

an electron gun arranged in a neck of the funnel, for emitting electron beams onto the phosphor screen;

5 and

a reinforcing band attached round an outer surface of the panel, for fastening the skirt portion,

wherein when a distance in a direction of the tube axis from a bonding part of the panel and the funnel to an end of the reinforcing band on the outer surface side of the effective portion is represented by a and a distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h, the reinforcing band is arranged to satisfy the following relationship:

$$a \geq 0.9h$$

3. A cathode-ray tube according to claim 2, wherein the reinforcing band has a bent portion formed by folding outwardly the end portion of the reinforcing band on the effective portion outer surface side; and

when a distance in the direction of the tube axis from the bonding part of the panel and the funnel to an end of the bent portion on the electron gun side is represented by b and a distance in the direction of the tube axis from the bonding part to the central position of the outer surface of the effective portion is

represented by h , the reinforcing band is arranged to satisfy the following relationship:

$$b \geq 0.7h$$

4. A cathode-ray tube according to claim 3,
 5 wherein when a thickness of the effective portion at an outer peripheral position of the phosphor screen is represented by t and a thickness of the effective portion at a central position of the phosphor screen is represented by t_c , the effective portion has a portion
 10 which satisfies the following relationship:

$$t \geq 1.5t_c$$

5. A cathode-ray tube comprising:
 a vacuum envelope including a panel which has a substantially rectangular effective portion having
 15 a substantially flat outer surface and having a phosphor screen formed on an inner surface and which has a skirt portion provided along a peripheral part of the effective portion and extending substantially perpendicular to the effective portion, and a funnel
 20 bonded to the skirt portion;
 an electron gun arranged in a neck of the funnel, for emitting electron beams onto the phosphor screen;
 and
 a reinforcing band attached round an outer surface
 25 of the panel, for fastening the skirt portion,
 wherein when a distance in the direction of a tube axis from the bonding part of the panel and the funnel

to a mold matching line of the panel is represented by \underline{c} and a distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by \underline{h} ,
5 the panel is arranged to satisfy the following relationship:

$$c \geq 0.8h$$

and;

10 the reinforcing band is attached round the skirt portion over the mold matching line.

6. A cathode-ray tube comprising:

a vacuum envelope including a panel which has a substantially rectangular effective portion having a substantially flat outer surface and having a
15 phosphor screen formed on an inner surface and which has a skirt portion provided along a peripheral part of the effective portion and extending substantially perpendicular to the effective portion, and a funnel bonded to the skirt portion;

20 an electron gun arranged in a neck of the funnel, for emitting electron beams onto the phosphor screen; and

a reinforcing band attached round an outer surface of the panel, for fastening the skirt portion,

25 wherein the reinforcing band has a bent portion formed by folding outwardly the end portion of the reinforcing band on the outer surface side of the

effective portion;

when a distance in a direction of the tube axis from a bonding part of the panel and the funnel to an end of the reinforcing band on the outer surface side of the effective portion is represented by a, when a distance in the direction of the tube axis from the bonding part of the panel and the funnel to the end of the bent portion on the electron gun side is represented by b, when a distance in the direction of the tube axis from the bonding part of the panel and the funnel to a mold matching line of the panel is represented by c and when a distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h, the reinforcing band and the panel are arranged to satisfy the following relationships:

$$a \geq 0.9h, b \geq 0.7h, c \geq 0.8h$$

and;

the reinforcing band is attached round the skirt portion over the mold matching line.

7. A cathode-ray tube according to claim 6, wherein when a thickness of the effective portion at an outer peripheral position of the phosphor screen is represented by t and a thickness of the effective portion at a central position of the phosphor screen is represented by t_c, the effective portion has a portion which satisfies the following relationship:

$$t \geq 1.5tc$$

8. A cathode-ray tube comprising:

a vacuum envelope including a panel which has
a substantially rectangular effective portion having
5 a substantially flat outer surface and having a
phosphor screen formed on an inner surface and which
has a skirt portion provided along a peripheral part of
the effective portion and extending substantially
perpendicular to the effective portion, and a funnel
10 bonded to the skirt portion;

an electron gun arranged in a neck of the funnel,
for emitting electron beams onto the phosphor screen;
and

a reinforcing band attached round an outer surface
15 of the panel, for fastening the skirt portion,

wherein the reinforcing band is attached round
the skirt portion over the mold matching line; and

the panel has a part where an angle θ defined
between the outer surface of the skirt portion from
20 the mold matching line of the panel to the outer
surface of the effective portion and a direction of the
tube axis is zero.

9. A cathode-ray tube according to claim 8,
wherein the angle θ is zero, only at each of corners of
25 the panel.

10. A cathode-ray tube according to claim 8,
wherein the reinforcing band has a bent portion formed

by folding outwardly the end portion of the reinforcing band on the outer surface side of the effective portion; and

when a distance in a direction of the tube axis from a bonding part of the panel and the funnel to an end of the reinforcing band on the outer surface side of the effective portion is represented by a, when a distance in the direction of the tube axis from the bonding part of the panel and the funnel to an end of the bent portion on the electron gun side is represented by b, when a distance in the direction of the tube axis from the bonding part of the panel and the funnel to the mold matching line of the panel is represented by c and when a distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h, the reinforcing band and the panel are arranged to satisfy the following relationships:

$$a \geq 0.9h, b \geq 0.7h, c \geq 0.8h$$

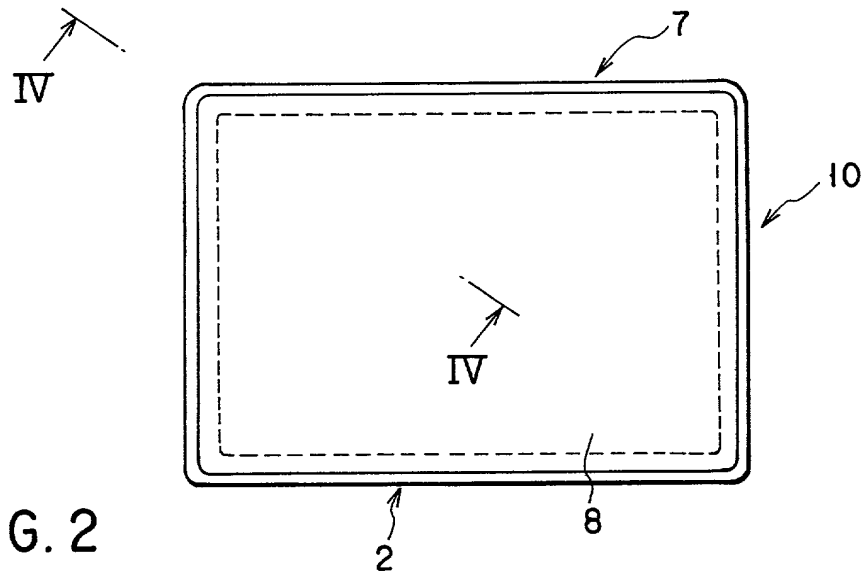
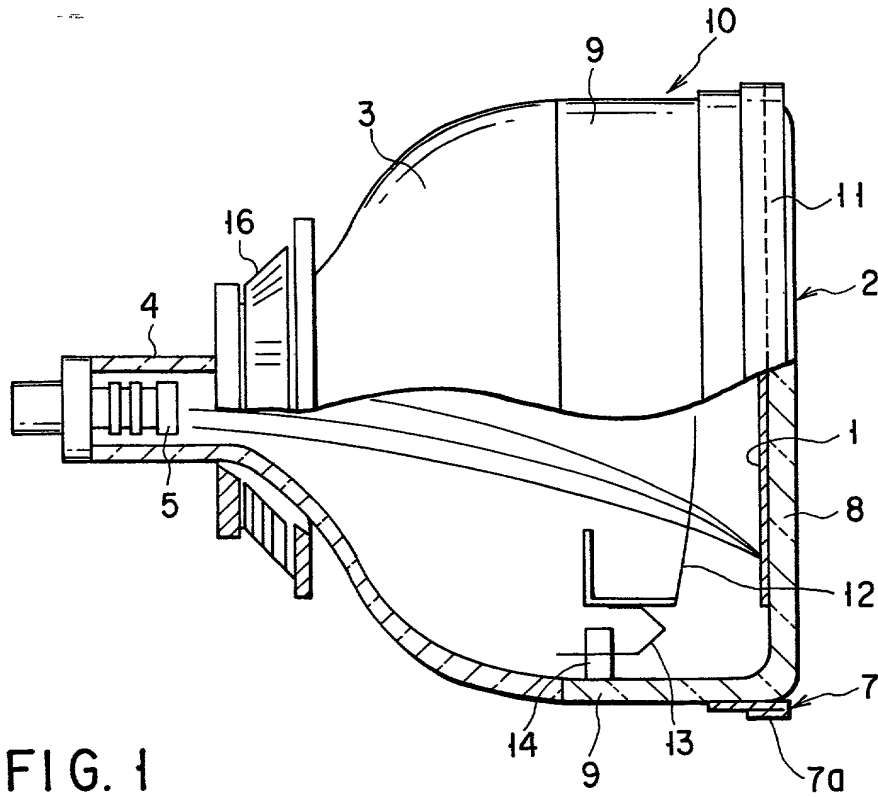
11. A cathode-ray tube according to claim 10, wherein when a thickness of the effective portion at an outer peripheral position of the phosphor screen is represented by t and a thickness of the effective portion at a central position of the phosphor screen is represented by tc, the effective portion has a portion which satisfies the following relationship:

$$t \geq 1.5tc$$

A B S T R A C T

A panel (2) of a vacuum envelope includes a substantially rectangular effective portion (8) having a substantially flat outer surface and also having a phosphor screen 1 formed on an inner surface, and a skirt portion (9) provided along a peripheral part of the effective portion and extended substantially perpendicularly to the effective portion. A funnel (3) is bonded to the skirt portion. A reinforcing band for fastening the skirt portion is attached round an outer surface of the skirt portion. When a distance in a direction of the tube axis from a bonding part between the panel and the funnel to an end of the reinforcing band on the outer surface side of the effective portion is represented by a and a distance in the direction of the tube axis from the bonding part to a central position of the outer surface of the effective portion is represented by h , the reinforcing band is arranged to satisfy $a \geq 0.9h$.

1/2



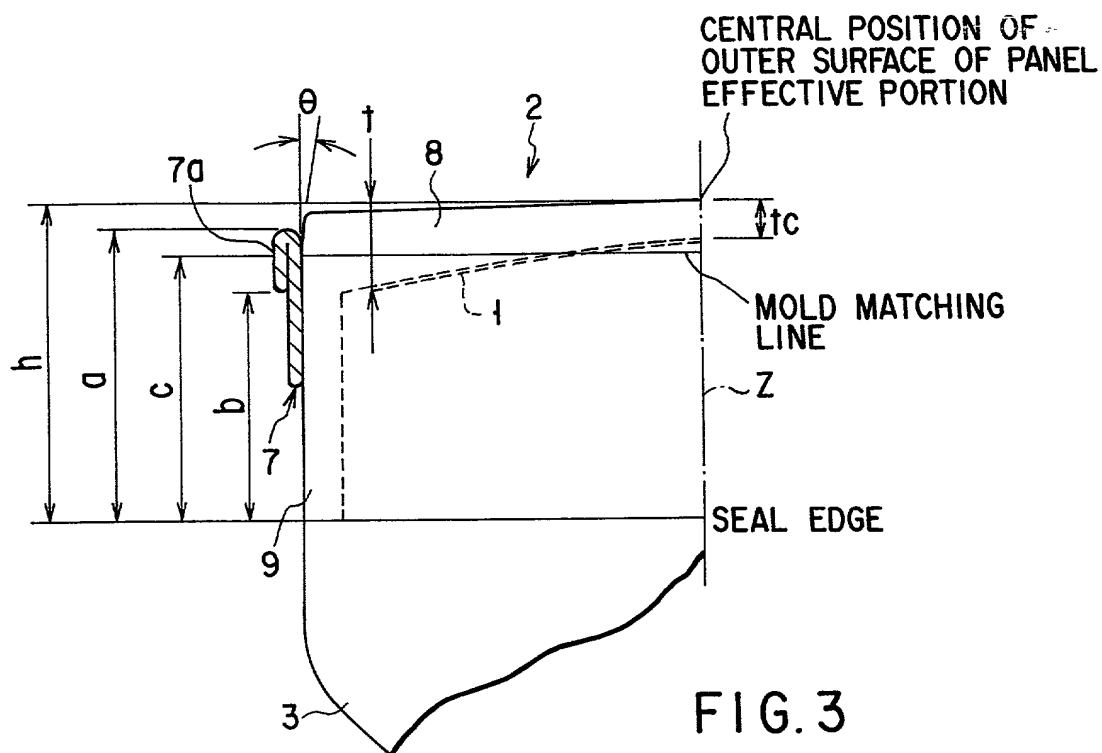


FIG. 3

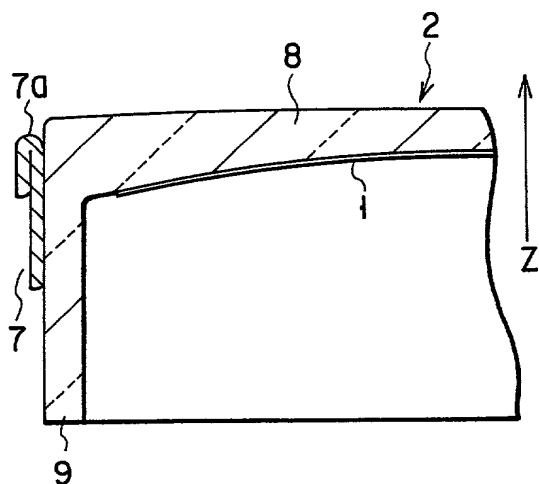


FIG. 4

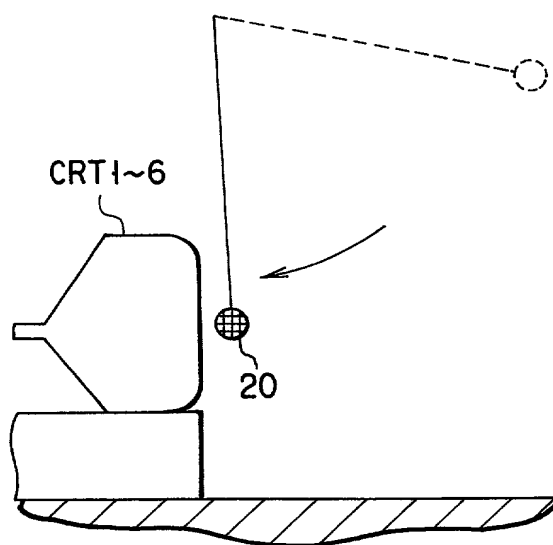


FIG. 5

DECLARATION FOR PATENT APPLICATION

(99S0926P1)

As a below named inventor, I declare that my residence, post office address and citizenship are as stated below above my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CATHODE-RAY TUBE ✓

the specification of which (check applicable box(es)).

☒ [X] is attached hereto.

☒ [X] was filed on February 15, 2000 as United States Application No. or PCT International Application No. PCT/JP00/00820. ✓

☐ [] and was amended on

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 35 U.S.C. 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Japanese Patent Application No. 11-035764, filed February 15, 1999 ✓ Priority Claimed

Japanese Patent Application No. 2000-014865, filed January 24, 2000 ✓ Priority Claimed

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s) or 35 U.S.C. 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application.

31 I hereby appoint as my attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Norman F. Oblon (Reg. No. 24,618), Marvin J. Spivak (Reg. No. 24,913), C. Irvin McClelland (Reg. No. 21,124), Gregory J. Maier (Reg. No. 25,599), Arthur I. Neustadt (Reg. No. 24,854), Richard D. Kelly (Reg. No. 27,757), James D. Hamilton (Reg. No. 28,421), Eckhard H. Kuesters (Reg. No. 28,870), Robert T. Pous (Reg. No. 29,099), Charles L. Gholz (Reg. No. 26,395), Vincent J. Sunderdick (Reg. No. 29,004), William E. Beaumont (Reg. No. 30,996), Robert F. Gnuse (Reg. No. 27,295), Jean-Paul Lavalleye (Reg. No. 31,451), Stephen G. Baxter (Reg. No. 32,884), Robert W. Hahl (Reg. No. 33,893), Richard L. Treanor (Reg. No. 36,379), Steven P. Weihrouh (Reg. No. 32,829), John T. Goolkasian (Reg. No. 26,142), Richard L. Chinn (Reg. No. 34,305), Steven E. Lipman (Reg. No. 30,011), Carl E. Schlier (Reg. No. 34,426), James J. Kulbaski (Reg. No. 34,648), Richard A. Neifeld (Reg. No. 35,299), J. Derek Mason (Reg. No. 35,270), Surinder Sachar (Reg. No. 34,423), Christina M. Gadiano (Reg. No. 37,628), Jeffrey B. McIntyre (Reg. No. 36,867), Paul E. Rauch (Reg. No. 38,591), William T. Enos (Reg. No. 33,128) and Michael E. McCabe, Jr., (Reg. No. 37,182), each of whose address is Fourth Floor, 1755 Jefferson Davis Highway, Arlington, Virginia 22202, or any one of them, and request that correspondence be directed to Oblon, Spivak, McClelland, Maier & Neustadt, P.C., Fourth Floor, 1755 Jefferson Davis Highway, Arlington, Virginia 22202.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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